

# Improving the Sponge Function of a Mediterranean Viticulture Soil under Global Change

Triple-C UTAD 2020

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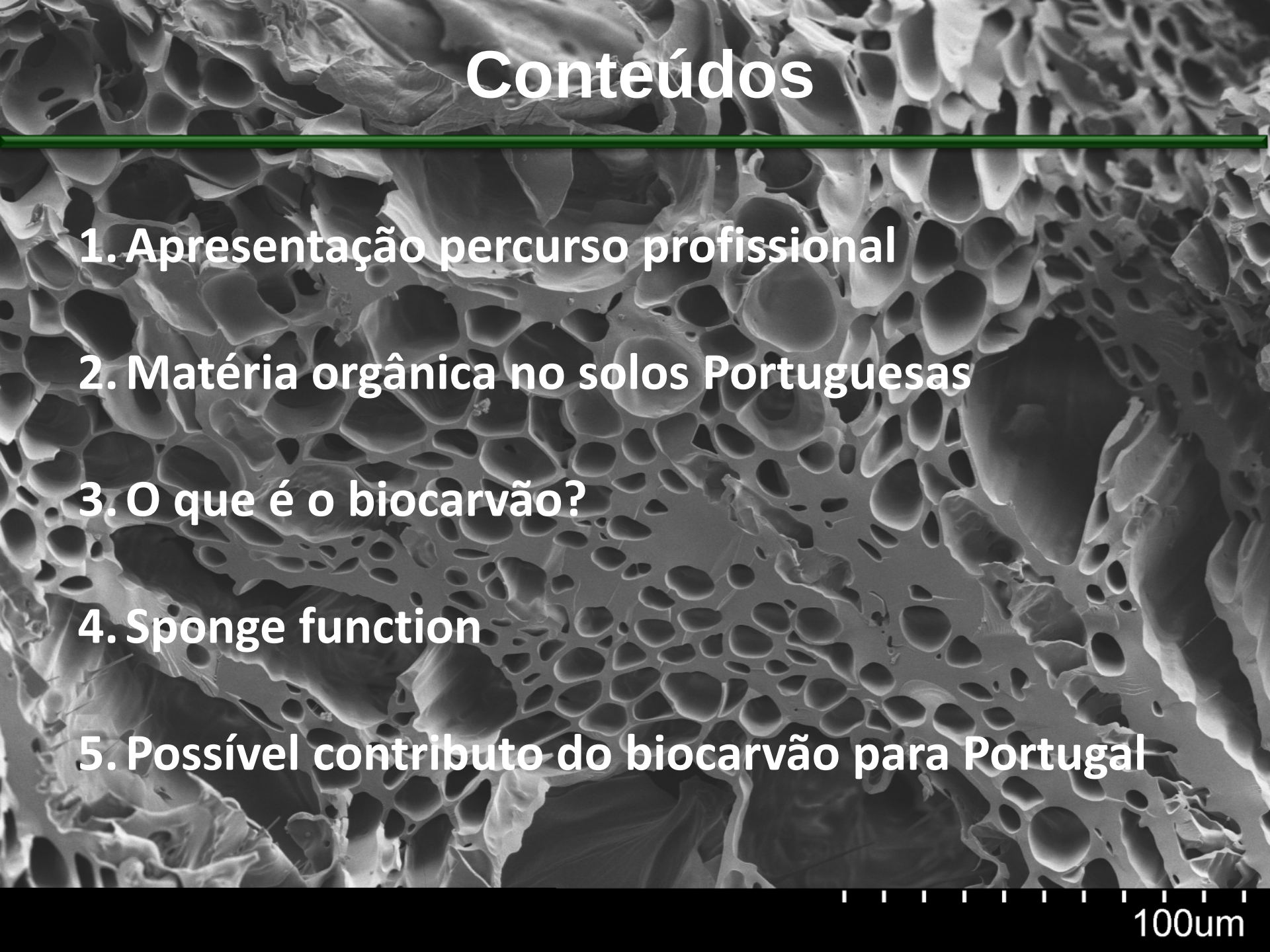


VISIT...

LANZAROTE  
*Caliente*.COM



# Conteúdos



1. Apresentação percurso profissional
2. Matéria orgânica no solos Portuguesas
3. O que é o biocarvão?
4. Sponge function
5. Possível contributo do biocarvão para Portugal

A scanning electron micrograph (SEM) showing a highly porous, cellular structure. The material consists of numerous interconnected, rounded, and elongated voids or cells, creating a honeycomb-like appearance. The walls of these cells are thin and irregular. The overall texture is rough and complex. Overlaid on the center of the image is the text "1. Percorso professionale" in a white, sans-serif font. At the bottom of the image, there is a black bar containing technical SEM data on the left and a scale bar on the right.

**1.  
Percorso professionale**

UTAS\_SU70 3.0kV x400 SE(M)

100um





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Cranfield  
UNIVERSITY

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University of London

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On-farm benefits from

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**SoilRes** - Aumento da resiliência dos solos  
com biochar derivado de resíduos: adaptação  
dos solos Portugueses às alterações  
climáticas



FCT Fundação para a Ciência e a Tecnologia  
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR Portugal

COMPETE

QR  
QUADRO DE REFERÊNCIA  
ESTRATÉGICO  
NACIONAL

UNIÃO EUROPEIA  
Fundo Europeu de Desenvolvimento Regional

BINP

Biochar Investigation Network of Portugal

[www.cesam.ua.pt/binp.pt](http://www.cesam.ua.pt/binp.pt)

COP15  
COPENHAGEN  
UNITED NATIONS CLIMATE CHANGE CONFERENCE 2009

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ies  
Instituto de  
Estudos  
Ambientais e  
Sociais

ELIR 34100 EN - 2010



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**CEEC Assistant Researcher position. Starting in April...?**

**Engineering the sponge function of Portuguese SOILs to sustainably COMBAT desertification (SOILCOMBAT)**

Sponge function = the proportion of rainfall that soil can retain.

1. the water holding capacity of the soil along its entire depth
2. the infiltration rate at the surface



[www.cesam.ua.pt/binp.pt](http://www.cesam.ua.pt/binp.pt)



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EUR 34000 EN - 2010



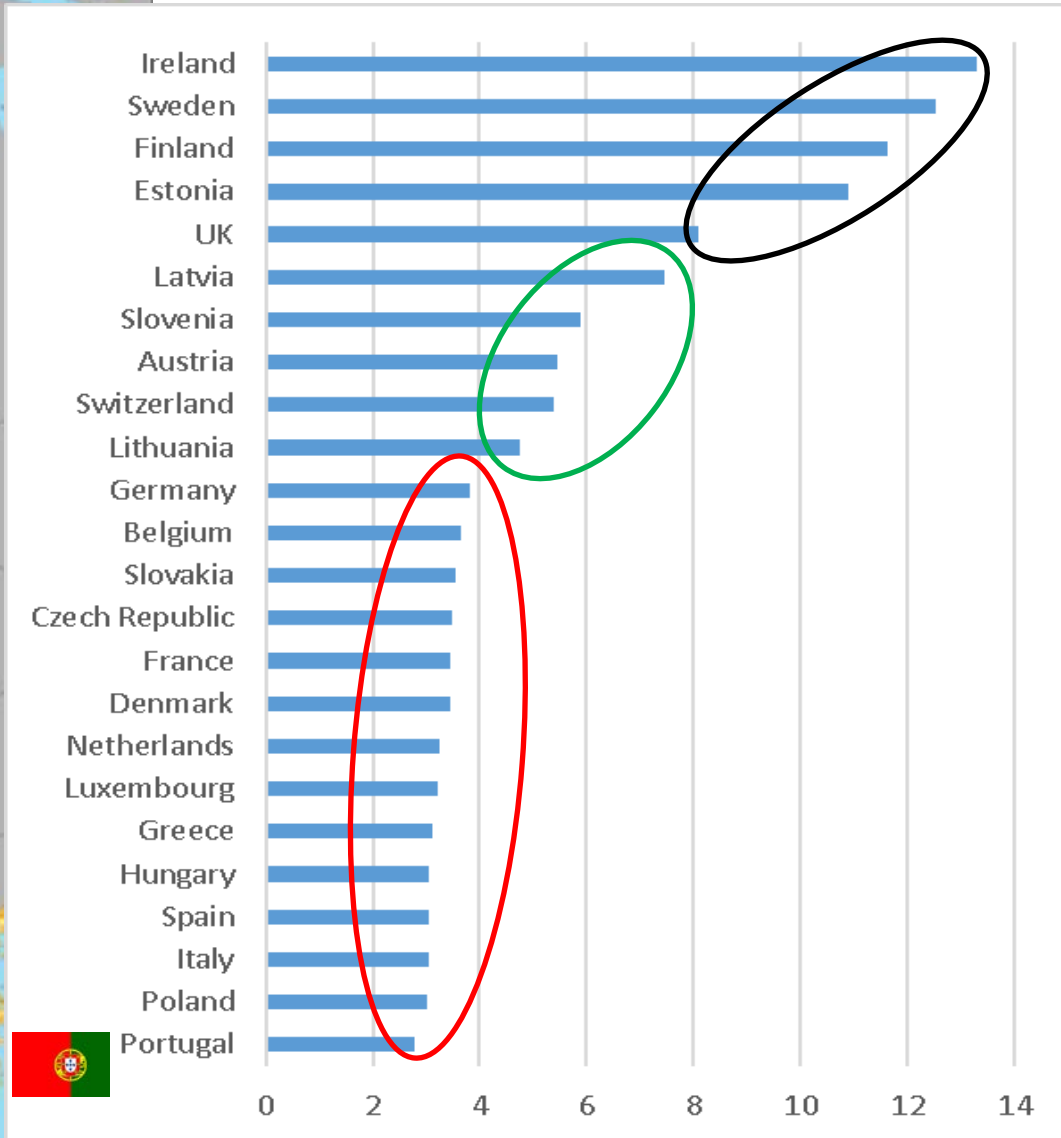
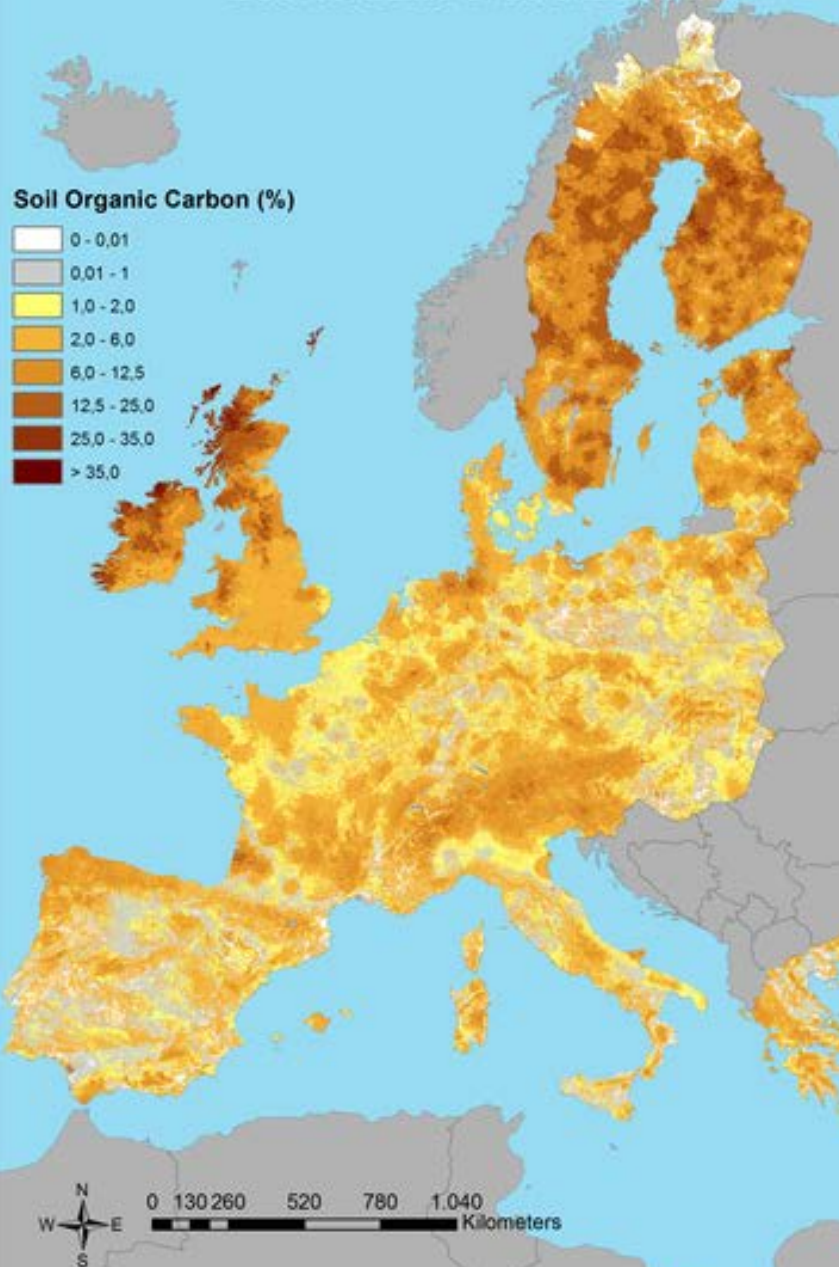
A scanning electron micrograph (SEM) showing a highly porous, cellular structure of soil organic matter. The image displays a complex network of interconnected, rounded, and elongated cells, creating a honeycomb-like appearance. The cells vary in size and shape, with some appearing more rounded and others more elongated. The overall texture is rough and irregular, with many small gaps and openings between the cells. The lighting highlights the three-dimensional nature of the structure, with some cells appearing more prominent than others.

## 2. Matéria orgânica no solos Portuguesas



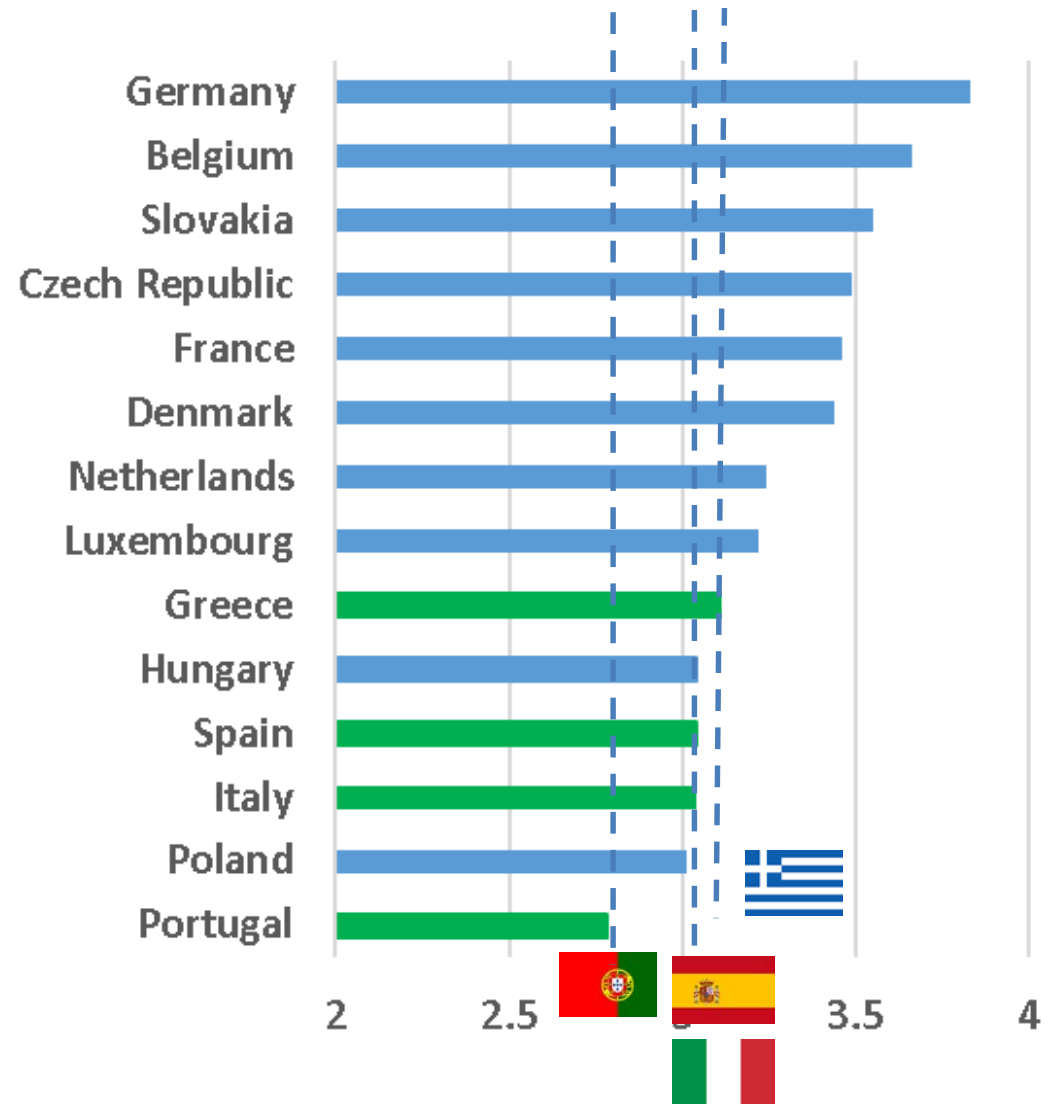
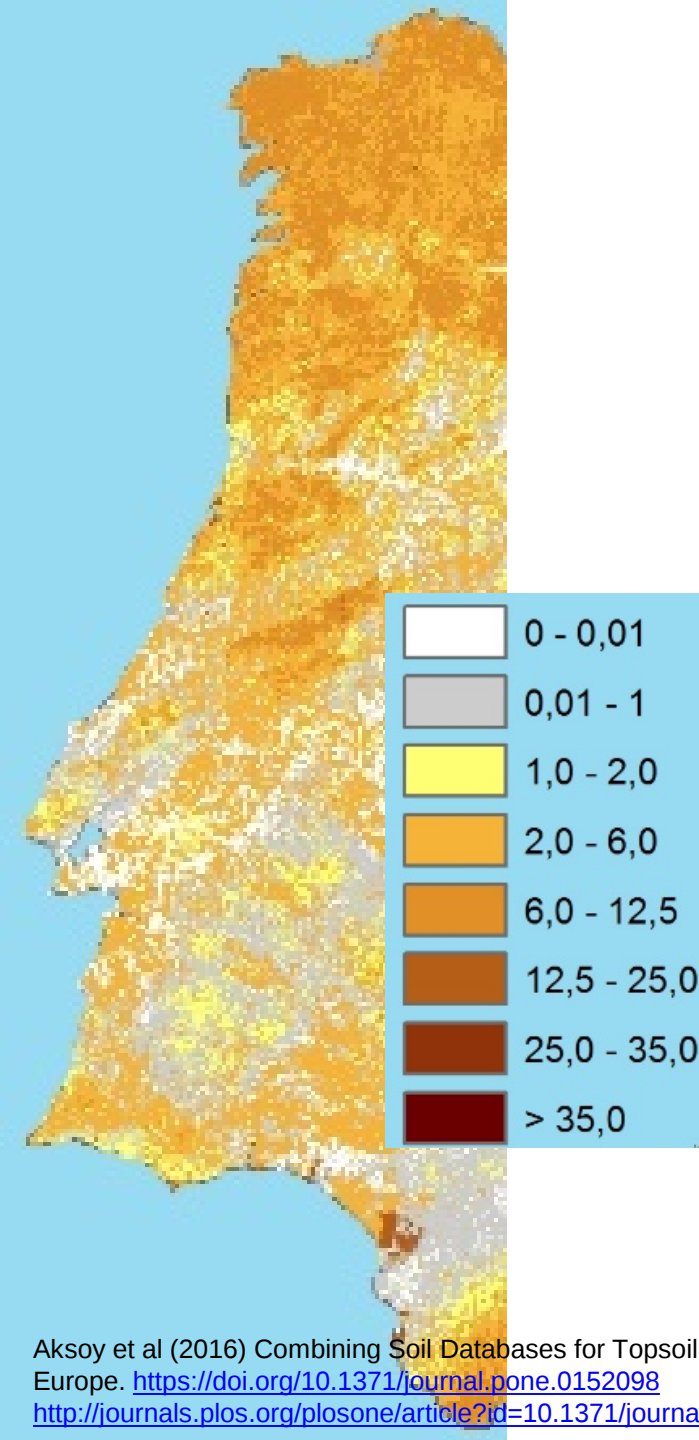
# Soil Organic Carbon Map of Europe LUCAS-CZOs-BIOSOIL Dataset

## % carbono orgânico no solo superficial





## % carbono orgânico no solo superficial



A scanning electron micrograph (SEM) showing a highly porous, honeycomb-like structure. The structure consists of numerous interconnected, rounded cells of varying sizes, creating a complex, three-dimensional network. The walls of the cells are thin and appear fibrous or layered. The overall texture is rough and irregular, with some larger, more prominent cells and many smaller ones. The lighting highlights the depth of the pores and the texture of the cell walls.

### 3. O que é o biocarvão?

# Propriedades do biocarvão

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## Consistentes

1. Cor escura
2. pH alcalino

## Variáveis

1. Força mecânica
2. Tamanho da partícula
3. Porosidade
4. Densidade
5. Conteúdo em cinzas
6. Conteúdo em voláteis
7. Conteúdo em nutrientes
8. Área específica de superfície (carga!)



# Serviços do ecossistema mediados pelos solos

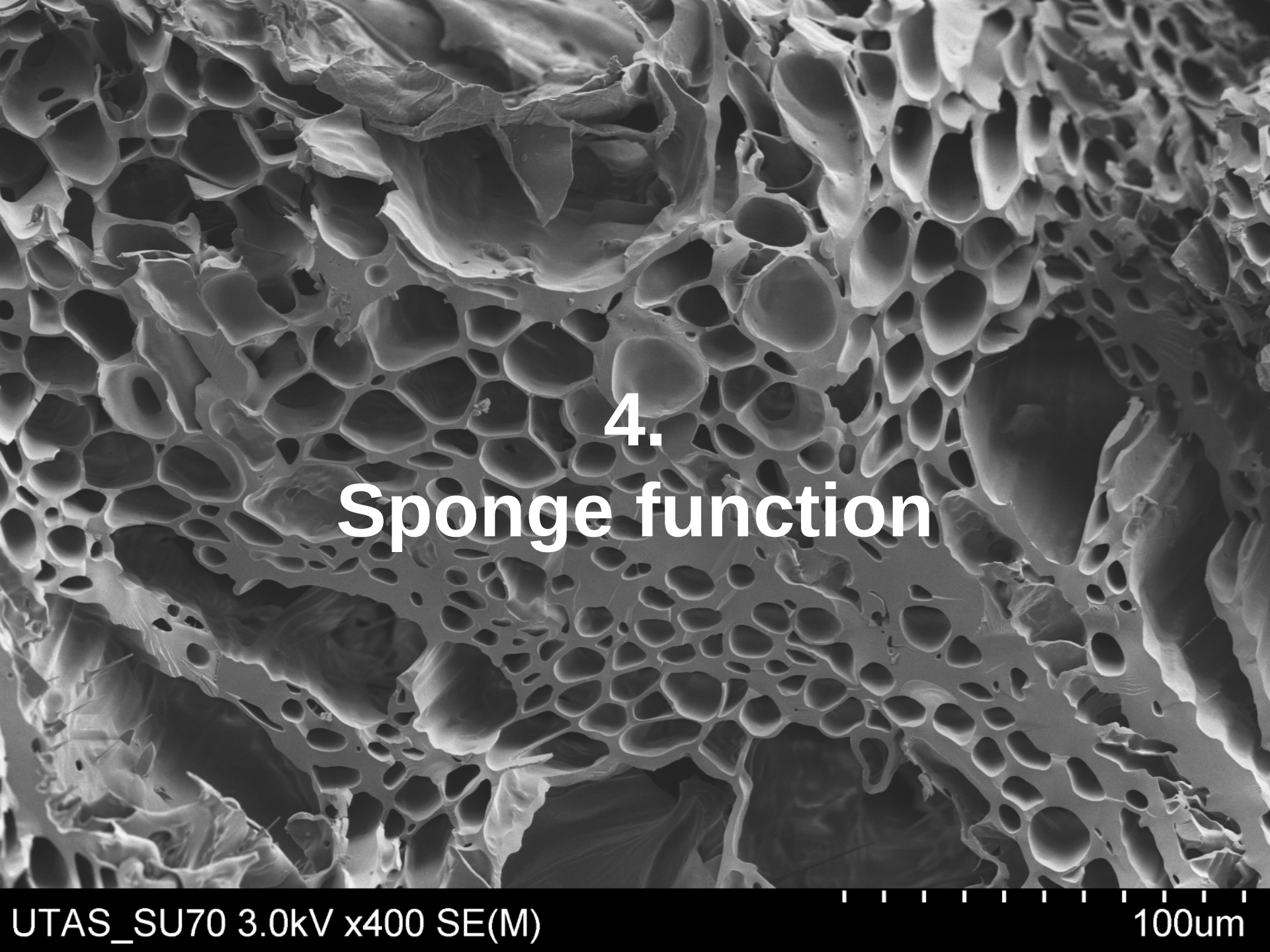
Kibblewhite et al (2008) Philosophical transactions of the Royal Society B

| Bens/produtos agrícolas               | Processos do solo envolvidos          |
|---------------------------------------|---------------------------------------|
| Produtos alimentares e fibras têxteis | Captura e transformação de nutrientes |
|                                       | Decomposição da matéria orgânica      |
|                                       | Dinâmica da matéria orgânica          |
|                                       | Manutenção da estrutura do solo       |
|                                       | Regulação das comunidades biológicas  |

Como promover este...

...e em simultâneo melhorar, ou evitar impactos negativos, nos restantes??

| Serviços não-agrícolas              | Processos do solo envolvidos           |
|-------------------------------------|----------------------------------------|
| Provisão e qualidade da água        | Manutenção da estrutura do solo        |
| Controlo da erosão                  | Transformação/reciclagem de nutrientes |
| Composição e regulação atmosférica  | Manutenção da estrutura do solo        |
| Atenuação e degradação de poluentes | Dinâmica da matéria orgânica           |
| Controlo de patógenos               | Decomposição enzimática/biológica      |
| Conservação da biodiversidade       | Reciclagem de nutrientes               |
|                                     | Regulação das comunidades biológicas   |
|                                     | Provisão de habitat                    |
|                                     | Regulação das comunidades biológicas   |

A scanning electron micrograph (SEM) showing a highly porous, sponge-like structure. The structure consists of a network of interconnected, irregular, rounded cells or chambers, creating a complex, three-dimensional lattice. The walls of these chambers are thin and appear fibrous or cellular in nature. The overall texture is rough and uneven, with varying depths and heights of the chambers. The lighting is directional, coming from the upper left, which creates strong highlights on the raised edges and deep shadows within the chambers, emphasizing the three-dimensional nature of the structure.

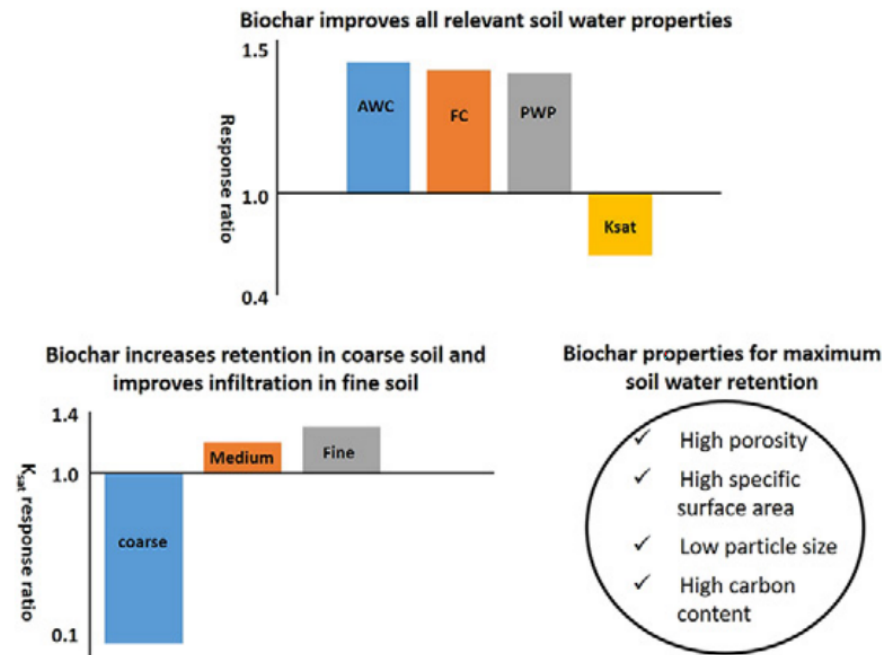
# 4. Sponge function

# Edeh et al., 2020

## HIGHLIGHTS

- Biochar effect on soil water was analysed using a Meta-analysis of 37 articles.
- Biochar generally increased the AWC (28.5%), FC (20.4%) and PWP (16.7%) of soils.
- Soil texture influenced how water characteristics responded to biochar addition.
- Biochar decreased  $K_{sat}$  of sandy soils and increased the  $K_{sat}$  of clayey soils.
- The effect of biochar was also dependent on its particle size, SSA, and porosity.

## GRAPHICAL ABSTRACT





THREE BIOCHAR PARTICLE SIZE CLASSES



Unsorted Particles



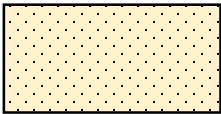
Small Particles



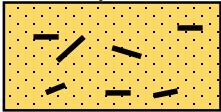
Large Particles

TWO SOIL TYPES

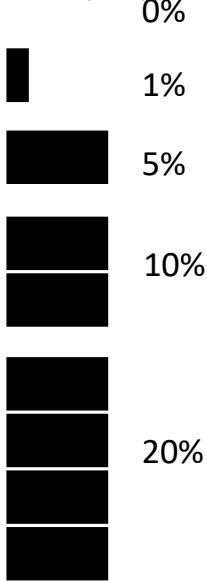
Sand



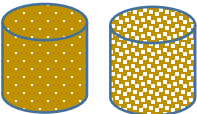
Sandy loam



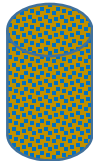
FIVE APPLICATION RATES (v/v)



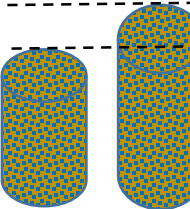
EFFECTS & INTERACTIONS



Bulk density

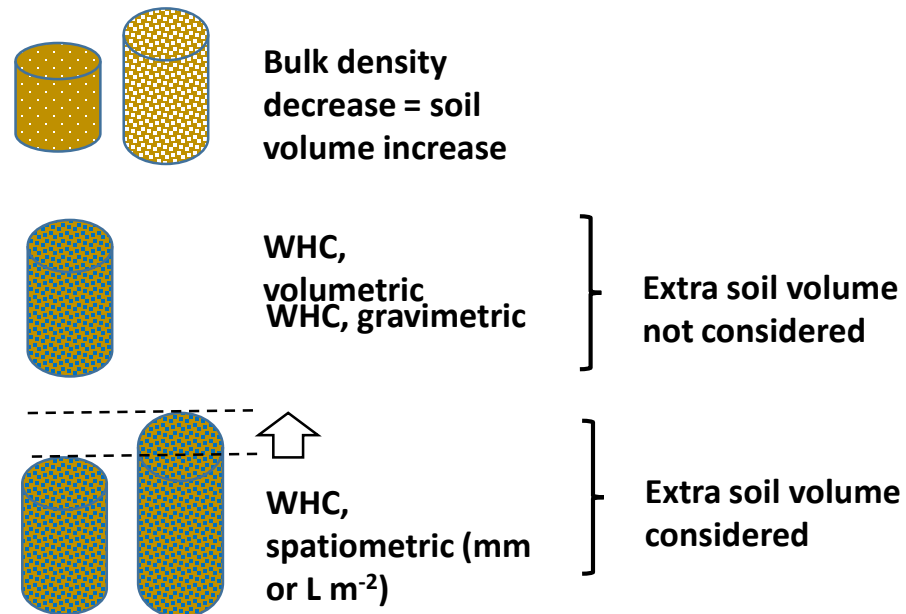


WHC, volumetric  
WHC, gravimetric

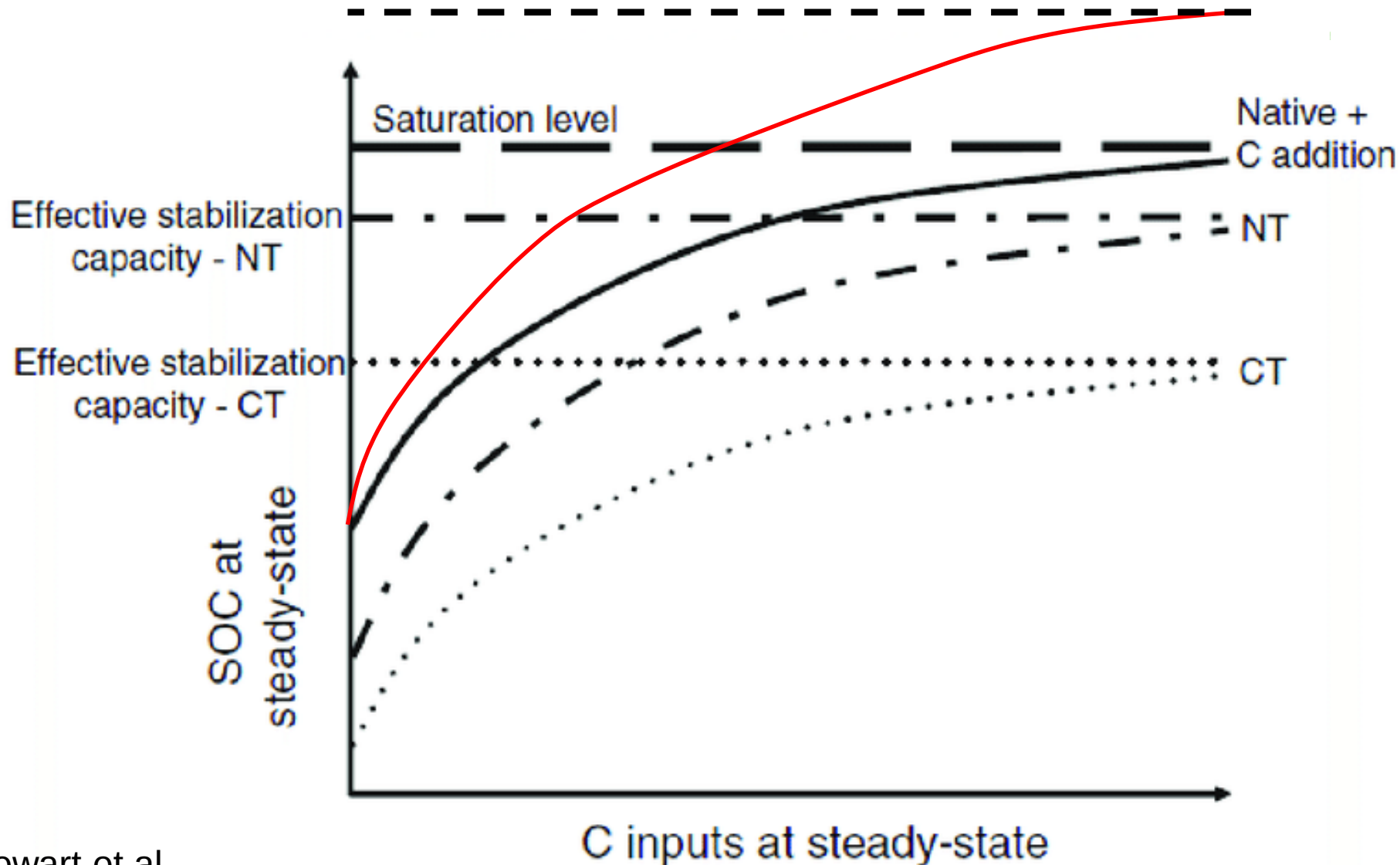


↑  
WHC, spatiometric

# Total soil water storage



# There is a practical upper limit to SOC



# Erosão do e infiltração no solo

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## Três experiências em diferentes escalas:

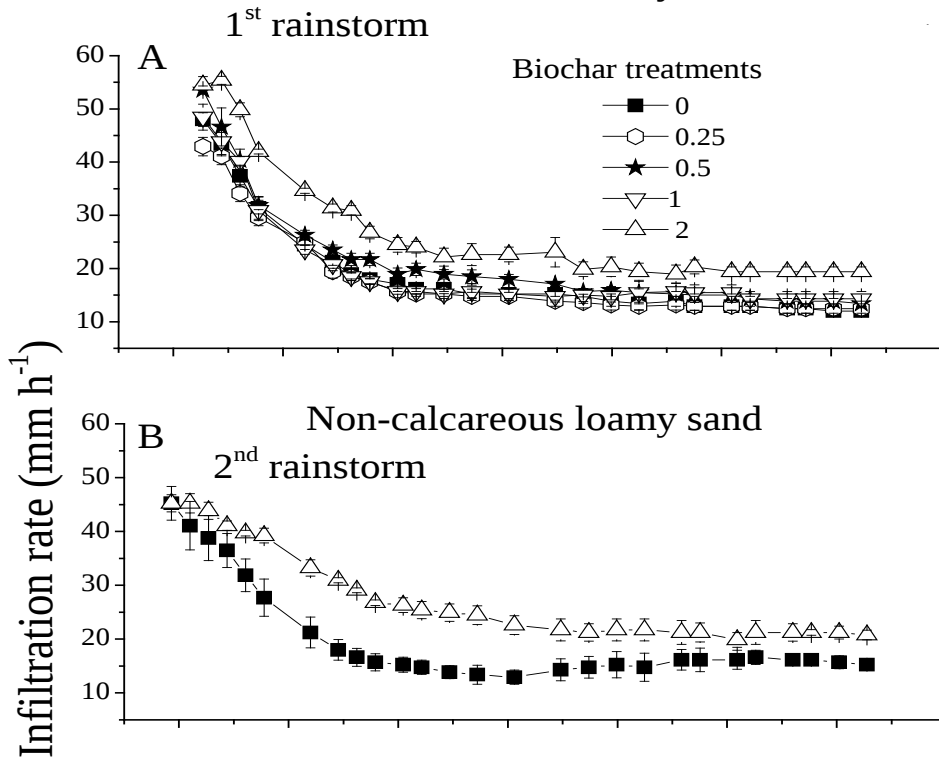
1. Laboratório (Israel)
2. Lisímetros (tanques em campo)
3. Campo (viticultura da Bairrada)





# 'Simulação de chuva' – laboratório (Israel)

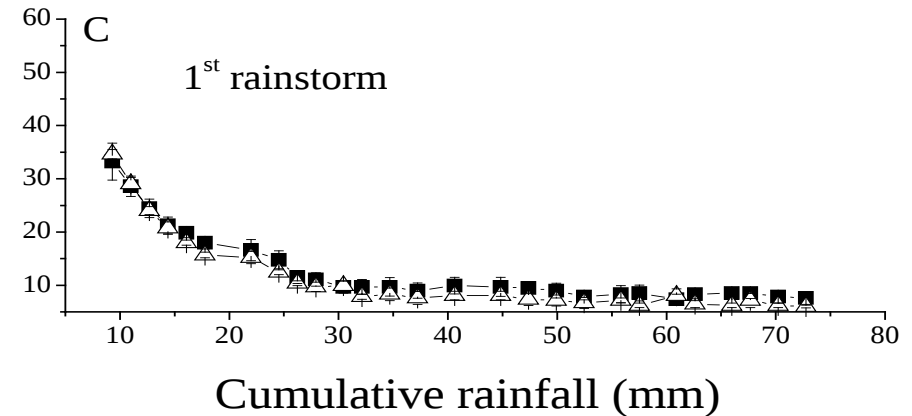
Aumento da taxa de infiltração nos solos argilosos não calcários (loamy sand)



3.6 vezes menor perda de solo!



Sem efeitos em solos calcários (calcareous loam)



1.3 vezes menor perda de solo!



# Capacidade de armazenamento de água - lisímetros



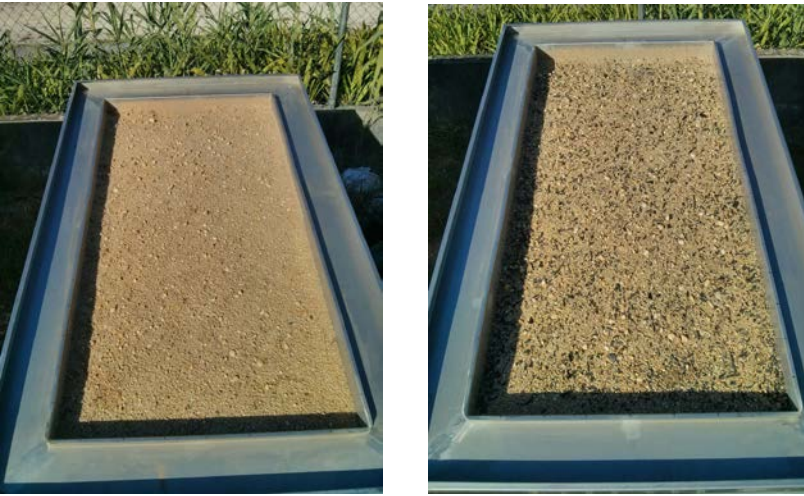
**Colaboração com  
ESAC (Coimbra)**

*MASCC*



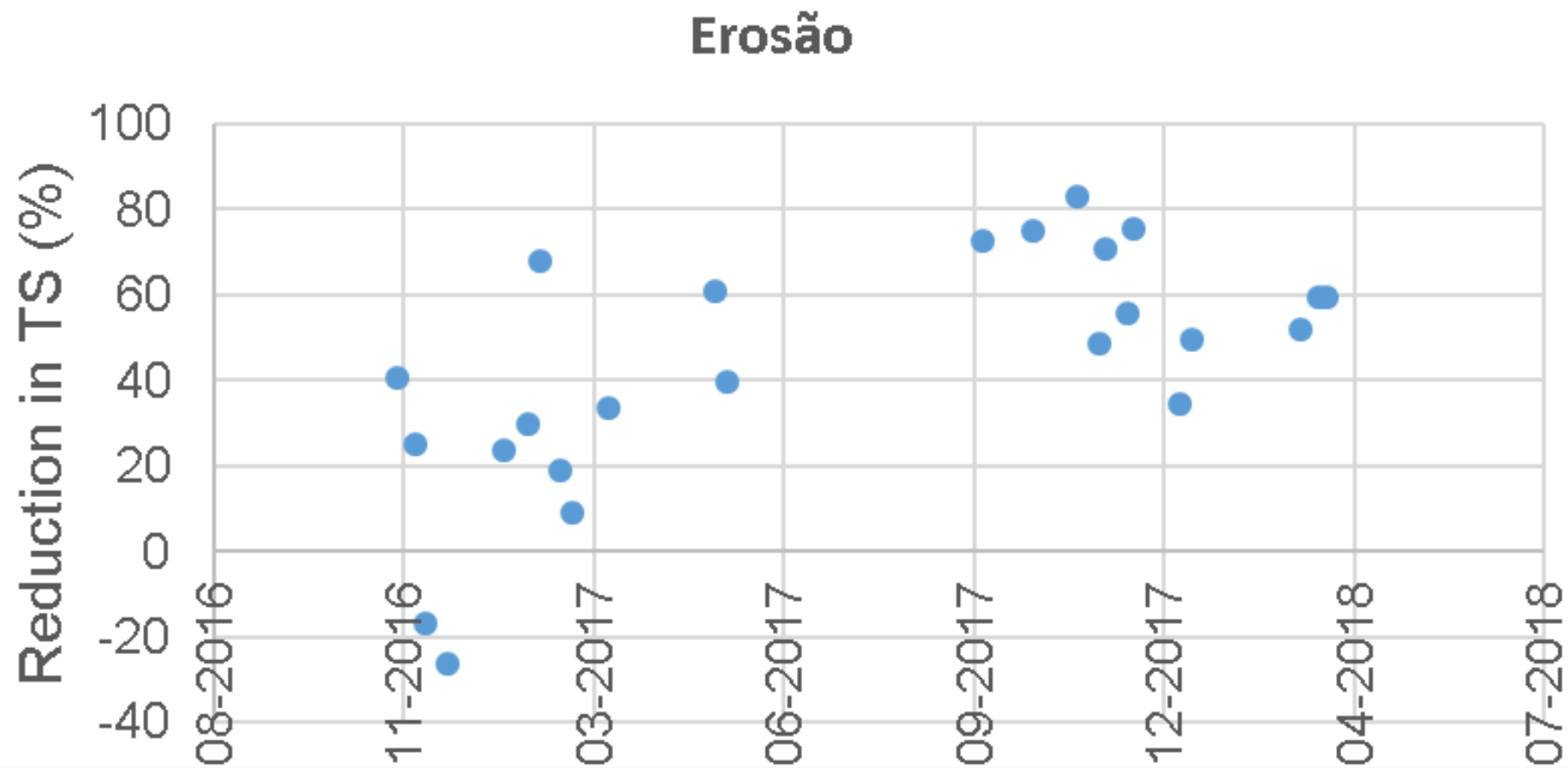


# Amostragem



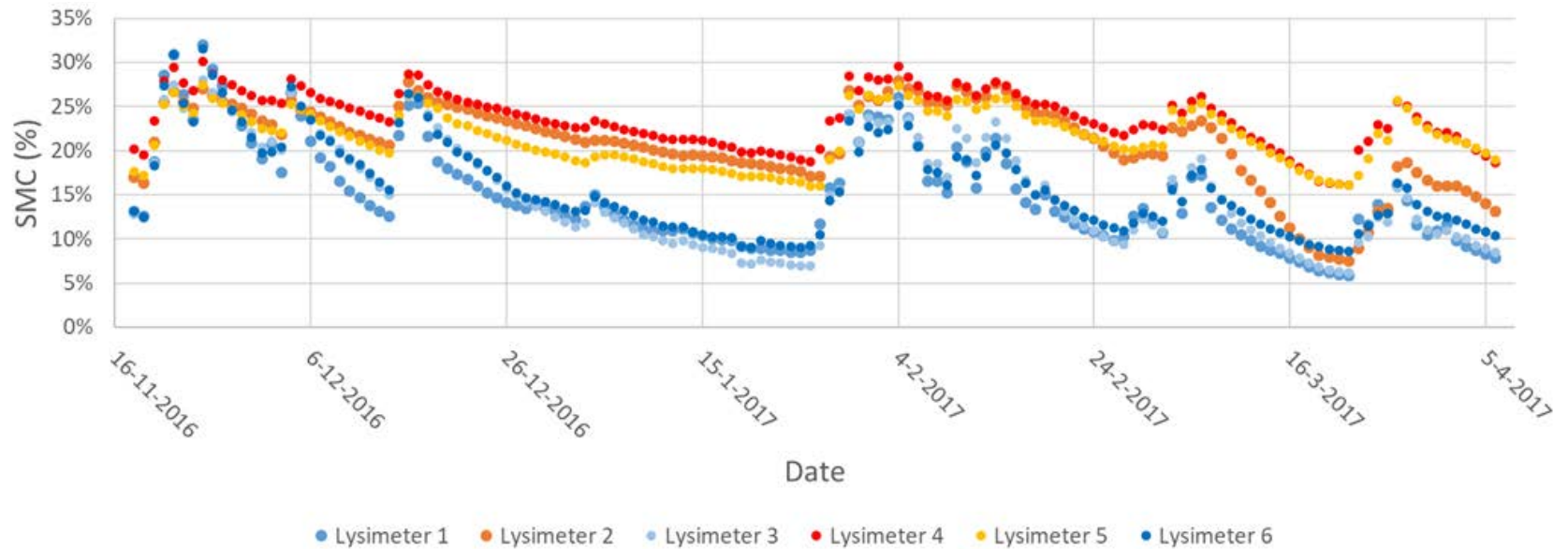
- Colheita de amostras:
  - Escorrência superficial
  - Percolação
  - Salpicos (splash)
  - Partículas maiores
- Registadores de dados (Em50)
- Pluviômetro (chuva)
- Sensores
  - HS10: verticalmente
  - 5TE: horizontalmente a 8 cm de profundidade

# Resultados

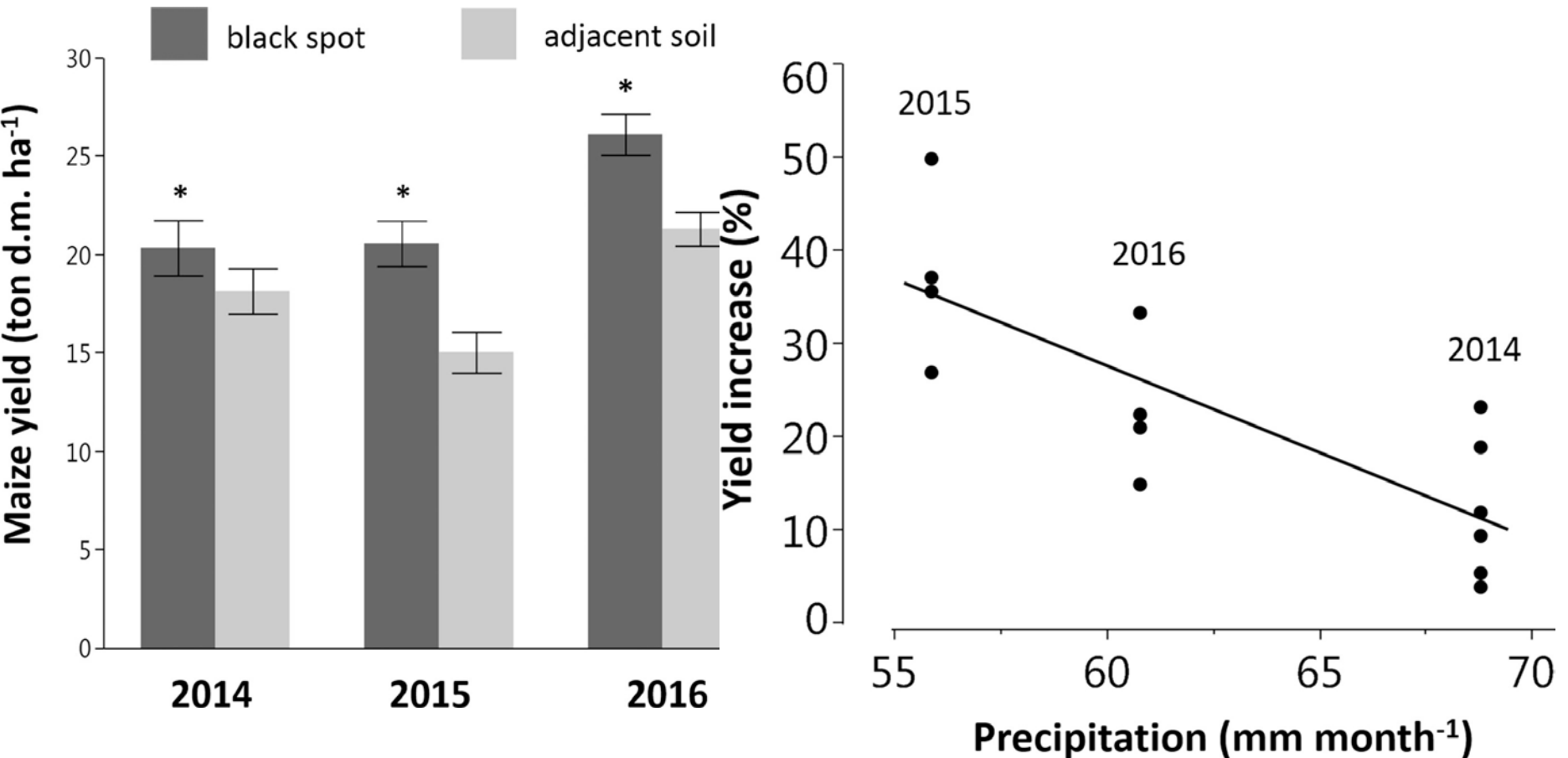




# Conteúdo de humidade do solo (media diária)



# Exemplo de campo da Bélgica (Kerré et al., 2017)



# Lysimeter Park experimental facility





Biochar  
(4% w/w)



control

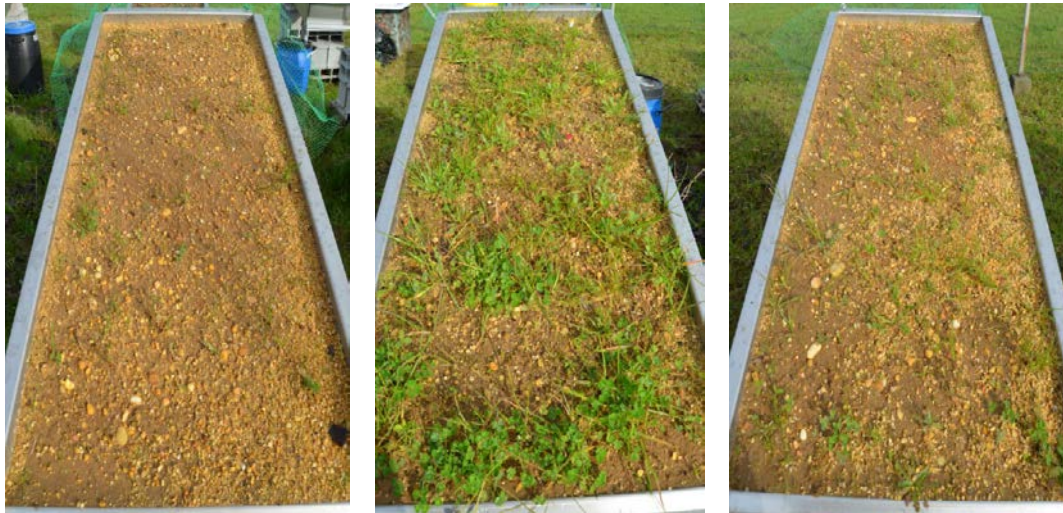




Biochar  
(4% w/w)



control



SPONGE function = WHCspatiometric + infiltration



5.

# Contributo do biocarvão para Portugal

# Mensagens para 'levar para casa'

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1. Os solos Portugueses têm muito pouco carbono
2. Aumento da capacidade de armazenamento de água nos solos
  1. Infiltração
  2. Retenção
3. Redução da erosão
4. Aplicação de biocarvões diferentes para serviços do ecossistema específicos (para evitar trade-offs)
5. A sustentabilidade do biocarvão requer investigação interdisciplinar!



# Obrigado pelo convite e pela atenção!



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